DOCUMENT RESUME

ED 139 937 CE 010 955

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TITLE Air Conditioning. Performance Objectives. Intermediate Course.
INSTITUTION Duval County School Board, Jacksonville, Fla.
PUB DATE Jul 72
NOTE 63p.; Not available in hard copy due to marginal reproducibility of the original document

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS *Air Conditioning; *Behavioral Objectives; *Criterion Referenced Tests; Job Skills; Management; *Refrigeration; Refrigeration Mechanics; Senior High Schools; Service Occupations; Shop Curriculum; Trade and Industrial Education

ABSTRACT

Several intermediate performance objectives and corresponding criterion measures are listed for each of seven terminal objectives for an intermediate air conditioning course. The titles of the seven terminal objectives are Refrigeration Cycle, Job Requirement Skills, Air Conditioning, Trouble Shooting, Performance Test, Shop Management, and S.I.E. Program. The document also includes a 50-item electrical test, a 50-item written final test, a 20-item electrical components test, and a 26-item air conditioning and refrigeration test (applied math). (This manual and 54 others were developed for various secondary level vocational courses using the System Approach for Education (SAFE) guidelines.) (HD)

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ED139937

INTERMEDIATE COURSE

AIR CONDITIONING

PERFORMANCE OBJECTIVES

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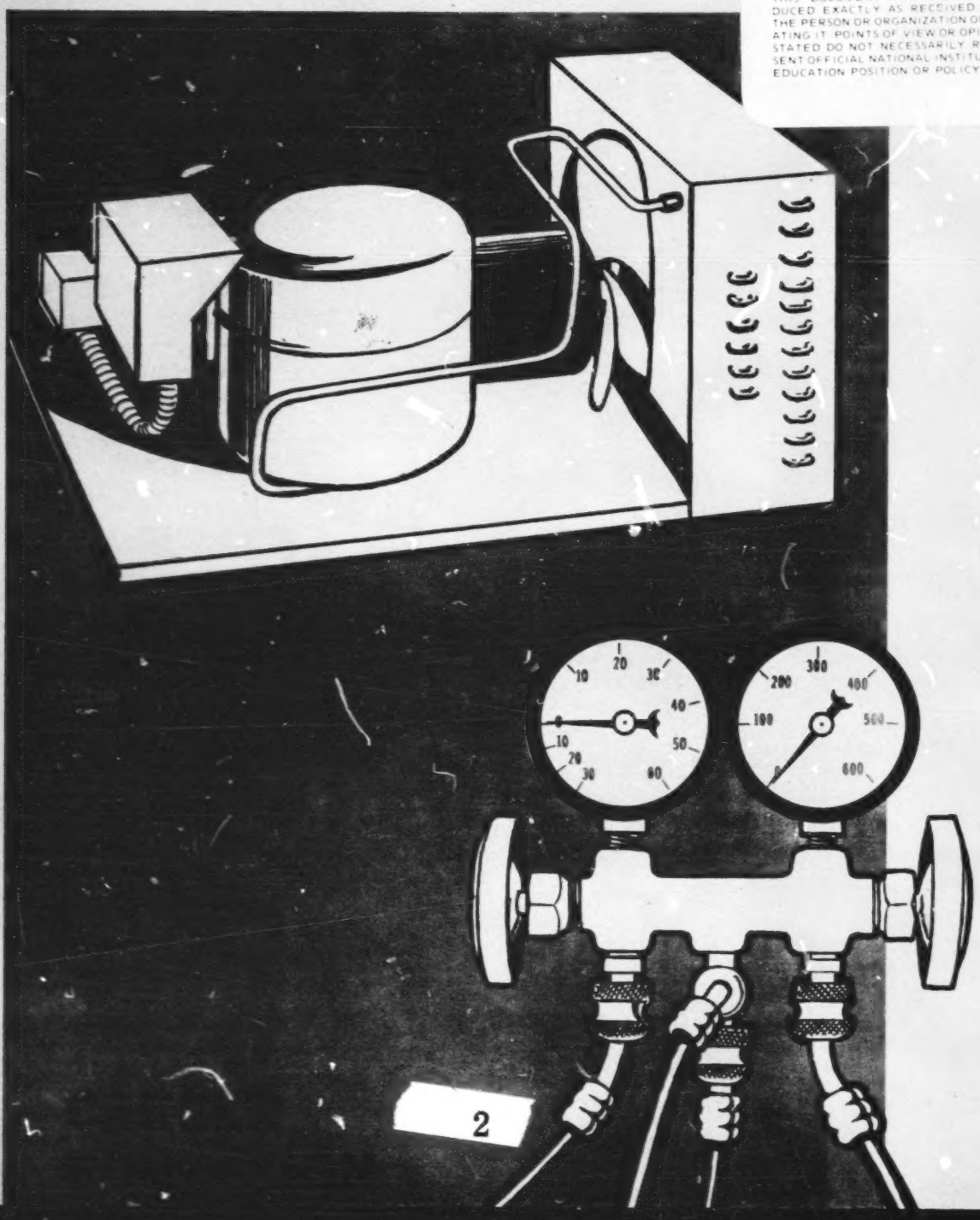

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Duval County Public Schools
July, 1972

ACKNOWLEDGEMENTS

This manual was developed using System Approach For Education (SAFE) guidelines.

Appreciation and recognition are extended to the following educator who has assisted in the preparation of this manual:

Mr. Joseph Killough, Coordinator
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The following educator participated as the writer of this manual:

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AIR CONDITIONING, REFRIGERATION AND HEATING

INTERMEDIATE 9015 AND ADVANCED 9017

Syllabus of Terminal Performance Objectives

9015

7.0 - Refrigeration Cycle

8.0 - Job Requirement Skills

9.0 - Air Conditioning

10.0 - Trouble Shooting

11.0 - Performance Test

12.0 - Shop Management

9017

13.0 - S.I.E. Program

OCCUPATIONAL (CRAFT) ADVISORY COMMITTEE

WE, the undersigned, members of the Air Conditioning & Heating Mechanics Craft Advisory Committee have reviewed this Intermediate Air Conditioning & Heating Mechanics Curriculum Guide. We do hereby certify that the contents of this guide are in line with current industry practices and will prepare the student for entry level employment in the air conditioning and heating mechanics trade.

Name	Position
Thomas Dryman	Plumbing Contractor
Harold A. Kelley	air Conditioning Contractor
Thomas DeLoman	Refrigeration Distributor
Bob Jenkins	Teacher Ed. White H/S
Walt Turner	Plumbing Contractor

ACCREDITATION NUMBER 9015

COURSE TITLE: AIR CONDITIONING, REFRIGERATION AND HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 7.0

REFRIGERATION CYCLE

Upon completion of the unit on Basic Refrigeration cycle the student will be able to identify the components of a refrigeration unit and explain the duty each performs in the refrigeration cycle.

No.	Intermediate Performance Objectives	No.	Criterion Measures
		7.0	The process will be evaluated by means of the criteria in the objective.
7.1	Given a test on Refrigeration terms the student will answer 75% correctly.	7.1	1. Define heat 2. Define the 3 basic methods of heat transfer and give examples. 3. Define cold 4. Define refrigeration 5. Define high and low side and tell where the dividing points are.
7.2	Upon completion of the unit on Compressor the student will demonstrate his proficiency by completely disassembling, name the parts, and reassemble an operating compressor.	7.2	The process will be evaluated by means of the criteria in the objective.
7.3	Given 5 questions on evaporators the student will answer 4 correctly.	7.3	1. The evaporator is a device to a) store refrigerant b) absorb heat into the Refrigerant system c) remove heat from the Refrigerant system d) disapate heat 2. Name the two types of evaporators a_____, b_____ 3. What pressure will an air conditioning evaporator operate that is charged with Refrigerant 22. 4. What will the pressure be on a Freezer evaporator charged with Refrigerant 12. 5. The heat picked up in the evaporator must equal a) the heat of compression

ACCREDITATION NUMBER 9015

COURSE TITLE: AIR CONDITIONING, REFRIGERATION AND HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 7.0 REFRIGERATION CYCLE

No.	Intermediate Performance Objectives	No.	Criterion Measures
		7.3	(Con't). b) the heat given up by the condenser c) the heat lost by the medium being cooled. d) the heat gained by the condenser.
7.4	Upon completion of this unit on condensers the student must know the application and care of the condenser and answer 4 of 5 attached questions correctly.	7.4	1. The main purpose of a condenser is to a) store liquid refrigerant b) remove heat from the refrigerant c) remove water from the refrigerant d) none of the above 2. There are Three basic types of condensers The _____ cooled The _____ cooled The _____ cooled 3. A condenser is a device for removing _____ from the refrigeration system. 4. The horizontal shell and tube condenser is _____ to clean. 5. Most heat removed from the refrigerant in a condenser is of the _____ variety.
7.5	Upon completion of this unit the student is required to know the types and function of the basic metering devices. He must be able	7.5	1. Name 4 of 6 metering devices. 2. The thermostatic expansion valve is controlled by the evaporator

ACCREDITATION NUMBER 9015

COURSE TITLE: AIR CONDITIONING, REFRIGERATION AND HEATING- INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 7.0 REFRIGERATION CYCLE

No.	Intermediate Performance Objectives	No.	Criterion Measures
7.5	(Con't.) to recognize malfunctions and answer with 75% accuracy.	7.5	(Con't.) 3. Superheat is the difference between the actual gas temperature and temperature corresponding to the _____. 4. The metering device is designed to a) keep the evaperator as cold as possible b) to control evaperator super heat c) control the flow of refrigerant d) none of the above 5. When high pressure drop is present in an evaporator, an _____ equalized thermostatic expansion valve is used.
7.6	Upon completion of this unit the student must know <u>when</u> to change a drier, <u>why</u> it should be changed, and <u>how</u> to change it. He must answer the 4 attached questions with 75% accuracy.	7.6	1. Should a strainer dryer be used a) why b) why not 2. An absorbent removes moisture by chemical action. (True or False) 3. Any system operating without "Freeze-ups" is almost certain to be dry. (True or False) 4. Sealed type dehydrators are generally used on small factory assembled equipment. (True or False
7.7	Upon completion of this unit the student must be able to identify the type of refrigerant by number (R-12) and chemical formula (CCl_2F_2). He will be only required to know the approximately 4 most commonly used refrigerants and answer the questions	7.7	1. Refrigerant properties can be classified as _____ and _____ 2. _____ properties are those properties of a refrigerant that have to deal with the movement of heat.

ACCREDITATION NUMBER 9015

COURSE TITLE: AIR CONDITIONING, REFRIGERATION AND HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 7.0 REFRIGERATION CYCLE

No.	Intermediate Performance Objectives	No.	Criterion Measures
7.7	Con't. attached. 70% accuracy required.	7.7	(Con't). 3. When a moisture saturated refrigerant is _____ water will be released. 4. Match the chemical number with the proper chemical formula. a) R-11 CCL_2/CH_3CHF_2 b) R-12 CCL_3F c) R-22 CCL_2F_2 d) R-500 $CHCLF_2$ e) 718 H_2O

FUNCTIONAL PERFORMANCE ANALYSIS

Terminal Performance Objective 7.0
Interim Performance Objective 7.1

No.	Learning Steps	No.	Criterion Performance Evaluation (Response)	No.	Method/Media Selection	Time Required
7.1.1	Define Heat.	7.1.1	Make a complete sentence in defining heat 100% accuracy re - quired.			
7.1.2	Give an example of each heat transfer.	7.1.2	Give the methods of heat transfer by the following: a. Conduction b. Convection c. Radiation 100% accuracy is required.			
7.1.3	Define Cold.	7.1.3	Make a complete sentence in defining cold 100% accuracy is required.			
7.1.4	Define Refrigeration.	7.1.4	To a degree of 100% accuracy give a complete definition of refrigeration.			
7.1.5	Define the high and low side.	7.1.5	To a degree of 100% accuracy tell the dividing line between the two.			
7.2.1	Disassemble a compressor.	7.2.1	Follow procedure for disassemble and assembling a compressor.	7.2.1	Out lined in modern refrigeration Ch. 15-44 page 606.	
7.2.2	Name all parts of a compressor.	7.2.2	Inspect all parts for wear and damage. Determine if any replacement parts are needed.			
7.2.3	Tag all parts of the compressor.	7.2.3	List all parts by name on the tags.			

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FUNCTIONAL PERFORMANCE ANALYSIS

Terminal Performance Objective 7.0
Interim Performance Objective 7.1

No.	Learning Steps	No.	Criterion Performance Evaluation (Response)	No.	Method/Media Selection	Time Required
.3.1	Identify function of the evaperator.	7.3.1	Write a response stating the operation characteristics of the evaperator.			
.3.2	Recall types of evaperators.	7.3.2	Given a visual display students will provide names and different types of evaporators.			
.3.3	Reading the temperature pressure chart.	7.3.3	The student must identify the operating pressures related to desired evaporator temperature when using freon-12.			
.3.4	Reading the temperature pressure chart.	7.3.4	The student must identify the operating pressures related to desired evaporator temperature when using freon-22.			
.4.1	Identify function of the condenser.	7.4.1	Write a response stating the operating characteristics of the condensers.			
.4.2	Recall types of condensers.	7.4.2	Given a visual display the students will provide names of the different types of condensers.			
.4.3	Locate condenser on visual display.	7.4.3	Identify each and write a statement for each cooling medium required for each condenser.			
.4.4	Describe the refrigerant within the condenser.	7.4.4	Write a response stating the normal operating temperature of the condenser and the physical state of the refrigerant within the condenser.			

FUNCTIONAL PERFORMANCE ANALYSIS

Terminal Performance Objective 7.0
Interim Performance Objective 7.1

No.	Learning Steps	No.	Criterion Performance Evaluation (Response)	No.	Method/Media Selection	Time Required
'.5.1	Describe types of metering devices.	7.5.1	Identify each metering device and write a distinguishing feature of each.			
'.5.2	Identify parts of a thermostatic expansion valve.	7.5.2	Write a response stating the function of the thermo-bulb, diaphragm, plunger, and orfice.			
'.5.3	Remove capillary tube from a unit.	7.5.3	Write a response on proper replacing the capillary tube.			
'.5.4	Recall types of metering devices.	7.5.4	Write a response stating the dividing line (high and low side) of the metering device and state the state of refrigerant in the device.			
'.6.1	Identify the strainer dryer.	7.6.1	Write a response stating the function of the filter dryer.			
'.6.2	Recognize the use of the strainer dryer.	7.6.2	Write a statement listing the normal location for the strainer dryer in a refrigeration system.			
.6.3	Respond to temperature difference across filter dryer.	7.6.3	Write statements giving reasons for temperature difference.			
'.7.1	Describe a refrigerant.	7.7.1	Identify the requirements for refrigerants.			
'.7.2	Classify and group six basic refrigerants.	7.7.2	Identify six basic refrigerants by number.			16

FUNCTIONAL PERFORMANCE ANALYSIS

Terminal Performance Objective 7.0
Interim Performance Objective 7.1

No.	Learning Steps	No.	Criterion Performance Evaluation (Response)	No.	Method/Media Selection	Time Requir
7.5.1	Describe types of metering devices.	7.5.1	Identify each metering device and write a distinguishing feature of each.			
7.5.2	Identify parts of a thermostatic expansion valve.	7.5.2	Write a response stating the function of the thermo-bulb, diaphragm, plunger, and orfice.			
7.5.3	Remove capillary tube from a unit.	7.5.3	Write a response on proper replacing the capillary tube.			
7.5.4	Recall types of metering devices.	7.5.4	Write a response stating the dividing line (high and low side) of the metering device and state the state of refrigerant in the device.			
7.6.1	Identify the strainer dryer.	7.6.1	Write a response stating the function of the filter dryer.			
7.6.2	Recognize the use of the strainer dryer.	7.6.2	Write a statement listing the normal location for the strainer dryer in a refrigeration system.			
7.6.3	Respond to temperature difference across filter dryer.	7.6.3	Write statements giving reasons for temperature difference.			
7.7.1	Describe a refrigerant.	7.7.1	Identify the requirements for refrigerants.			18
7.7.2	Classify and group six basic refrigerants.	7.7.2	Identify six basic refrigerants by number.			

FUNCTIONAL PERFORMANCE ANALYSIS

Terminal Performance Objective 7.0
Interim Performance Objective 7.1

No.	Learning Steps	No.	Criterion Performance Evaluation (Response)	No.	Method/Media Selection	Time Requir
7.7.3	Recognize safety regulations.	7.7.3	Orally state two safety regulations for handling refrigerants.			
7.7.4	Identify refrigerant cylinders.	7.7.4	Identify cylinders by standard color code.			

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ACCREDITATION NUMBER 9015

COURSE TITLE: AIR CONDITIONING, REFRIGERATION & HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 8.0 JOB REQUIREMENT SKILLS

Upon completion of the unit on Basic Refrigeration Job Requirement Skills, the student will have performed 75% of these skills

No.	Intermediate Performance Objectives	No.	Criterion Measures
8.		8.0	The student shall demonstrate his ability to perform the physical skills required to service, a refrigeration unit, such as correctly removing and replacing defective parts, evacuating and charging a system and evaluating its performance as compared with design specifications.
8.1	Upon completion of this unit the student will demonstrate his ability to successfully find a leak in a refrigeration system, using Halide Leak Detector and Electronic Leak Detector.	8.1	The student will use the Halide Leak Detector and Electronic leak detector to locate successfully all leaks in a system prepared by the instructor.
8.2	Upon completion of this unit the student must be able to demonstrate the proper procedure used to evacuate a system.	8.2	Using a vacuum pump the student will pump down a system to 29" as measured by combination guage on manifold and hold it for a period of 30 minutes.
8.3	Upon completion of this unit the student will demonstrate the proper procedure in correctly charging a system with refrigerant.	8.3	Using a charging cylinder, the student will charge, with 100% accuracy, a system with the correct amount of refrigerant as given in the design specifications of the system used.
8.4	Upon completion of this unit the student will demonstrate his ability to determine if a system is operating with the correct pressure on the high and low sides.	8.4	Using suitable guages the student will determine with 90% accuracy if a system is operating within its original design specifications.
8.5	Upon completion of this unit the student must be able to demonstrate the skills required to replace defective components in a refrigeration system.	8.5	The student will physically remove a compresser/evaporator/condenser from a system and replace it free from leaks, neat soldering joints, and

ACCREDITATION NUMBER 9015

COURSE TITLE: AIR CONDITIONING, REFRIGERATION AND HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 8.0

JOB REQUIREMENT SKILLS

No.	Intermediate Performance Objectives	No.	Criterion Measures
		8.5	(Con't.) operating satisfactorly within its original design specifications.

Terminal Performance Objective 8.0
Interim Performance Objective 8.1

No.	Learning Steps	No.	Criterion Performance Evaluation (Response)	No.	Method/Media Selection	Ti Requ
8.1.1	Locate leaks by soap bubble method.	8.1.1	Given length of pressurized tubing with pin hole leaks, student will locate 100% of leaks.	8.1.1	Copper tubing compressed air supply soap solution.	
8.1.2	Recognize presence of refrigerant leak by color change flame on Halide Torch.	8.1.2	Given a refrigerant charge component with a pin hole leaks, student will observe color change Halide Torch flame.	8.1.2	Halide Torch prepared system refrigerant cylinder.	
8.1.3	Calibrate on electronic leak detector.	8.1.3	Demonstrate ability to correctly set up an electronic leak detector.	8.1.3	Electronic leak detector (G.E. H-10 or equivalent) test leak.	
8.1.4	Correctly use an electronic leak detector.	8.1.4	Correctly locate refrigerant leak in component set up by instructor.	8.1.4	Electronic leak detector charged component with test leak.	
8.2.1	Explain the reasons for evacuating a system.	8.2.1	Student will write a short essay on reasons for evacuation of system.	8.2.1	Lecture, Demonstration	
8.2.2	Identify fittings used on vacuum pump.	8.2.2	Given visual display student will identify fittings.	8.2.2	Lecture, Transparencies	
8.2.3	Demonstrate ability to correctly read a compound gauge.	8.2.3	Given visual display student will respond to sample reading.	8.2.3	Lecture, Transparencies	
8.2.4	Demonstrate ability to correctly connect vacuum pump to system.	8.2.4	Student will practice connecting pump to system.	8.2.4	Lecture, Demonstration	
8.2.5	Correctly pump a vacuum on a system.	8.2.5	Student will operate pump.	8.2.5	Lecture, Demonstration	

Terminal Performance Objective 8.0
Interim Performance Objective 8.1

No.	Learning Steps	No.	Criterion Performance Evaluation (Response)	No.	Method/Media Selection	Ti Requ
8.3.1	Identify parts and fittings of charging cylinder.	8.3.1	Given a visual display student will correctly identify parts of charging cylinder.	8.3.1	Lecture, Transparancy	
8.3.2	Demonstrate ability to select correct dial indicator.	8.3.2	Correctly align correct dial indicator with sight glass.	8.3.2	Lecture, Demonstration	
8.3.3	Demonstrate ability to read sight glass.	8.3.3	Student will bleed exactly 2 oz. of charge from cylinder.	8.3.3	Lecture, Demonstration	
8.3.4	Demonstrate ability to prepare cylinder for use.	8.3.4	Properly connect charging cylinder to system.	8.3.4	Lecture, Demonstration	
8.3.5	Use charging cylinder correctly.	8.3.5	Charge a system with design specified amount of refrigerant to 100% accuracy.	8.3.5	Lecture, Demonstration	
8.4.1	Identify parts of manifold and gauge.	8.4.1	Demonstrate knowledge of relationship of gauges and values on manifold.	8.4.1	Lecture, Transparencies	
8.4.2	Read and evaluate high and low side pressures on gauges.	8.4.2	Read and record high and low side pressure on chart and compare with manufacture specification.	8.4.2	Lecture, Demonstration Chart	
8.5.1	Identify component parts of system and direction of refrigerant flow.	8.5.1	Given a visual display student will provide names with 100% accuracy and show correct direction of refrigerant flow.	8.5.1	Lecture, Transparencies	
8.5.2	Determine proper method of removal of component.	8.5.2	On sample system give the best method; I.E. desoldering, cutting or disconnecting fittings, and reason for method selected.	8.5.2	Lecture, Demonstration	

FUNCTIONAL PERFORMANCE ANALYSIS

Terminal Performance Objective 8.0
Interim Performance Objective 8.1

No.	Learning Steps	No.	Criterion Performance Evaluation (Response)	No.	Method/Media Selection	Time Spent
8.5.3	Removal and replacement of component parts in system.	8.5.3	Demonstrate proficiency in physical skills used in disconnecting and reconnecting tubing and component parts.	8.5.3	Lecture, Demonstration	

ACCREDITATION NUMBER 9015

COURSE TITLE: AIR CONDITIONING, REFRIGERATOR, AND HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO 9.0 AIR CONDITIONING

Upon the completion of this unit on air conditioning the student will be able to identify the components of an air conditioning unit and explain the relationship of its operation to the unit as a whole.

No.	Intermediate Performance Objectives	No.	Criterion Measures
		9.0	The process will be evaluated by means of the criteria in the objective.
9.1	Upon completion of this unit on cooling air the student. Must be able to trouble shoot and remedy the malfunctions that may develop in the heat removal component of the system and answer 3 of 4 of the attached questions.	9.1	Name the heat removal component of the refrigeration system. Explain the basic process of removing heat. In the process of cooling a given area cold air is added to the room. (True or False) Poor air distribution and poor refrigerant distribution give _____ symptoms. a) The same b) Different Performance: He must locate the problem and place system in operation within its original designed specifications.
9.2	Upon completion of this unit the student must recognize the different types of heating apparatus and controls with 100% accuracy. They must also answer the attached questions with 100% accuracy.	9.2	1. State the function of the following controls. a) Thermostat b) Protector Relay c) Heat relay d) Fan relay 2. Identify the following terminals of the heating and cooling thermostat R,-Y,-G,-W, 3. Name the operating parts of an oil fired furnace.

FUNCTIONA PERFORMANCE ANALYSIS

Terminal Performance Objective 9.0
Interim Performance Objective 9.1

No.	Learning Steps	No.	Criterion Performance Evaluation (Response)	No.	Method/Media Selection	T Req
9.1.1	Install manifold gauge set.	9.1.1	Connect flexible line from compound gauge of manifold to low side service valve of the compressor. Connect flexible line from high side pressure gauge of manifold to discharge (high side) service valve of the compressor. Remove flexible line from center part. Use $\frac{1}{4}$" flare cap to cap off center part.			
9.1.2	Purge manifold and lines.	9.1.2	Slightly open unit high side service valve. Close highside service valve. Open manifold valves a + b loosen flexible lines at service valve allowing pressure in lines to escape. Tightened flexible lines to unit service valves.			
9.1.3	Check system operating pressure.	9.1.3	Open (front seat) low side service valve by turning in (clockwise) $\frac{1}{4}$ turn record pressures analyze problem.			
9.1.4	Check system for insufficient cooling.	9.1.4	Remove fan compartment panel check blower belt tension check air filter. Check blower for cleanliness replace fan compartment panel, remove access panel from evaporator compartment. Inspect evaporator.			

FUNCTIONAL PERFORMANCE ANALYSIS

Terminal Performance Objective 9.0
Interim Performance Objective 9.1

No.	Learning Steps	No.	Criterion Performance Evaluation (Response)	No.	Method/Media Selection	Time Require
.1.1	Install manifold gauge set.	9.1.1	Connect flexible line from compound gauge of manifold to low side service valve of the compressor. Connect flexible line from high side pressure gauge of manifold to discharge (high side) service valve of the compressor. Remove flexible line from center part. Use $\frac{1}{4}$" flare cap to cap off center part.			
.1.2	Purge manifold and lines.	9.1.2	Slightly open unit high side service valve. Close highside service valve. Open manifold valves a + b loosen flexible lines at service valve allowing pressure in lines to escape. Tightened flexible lines to unit service valves.			
.1.3	Check system operating pressure.	9.1.3	Open (front seat) low side service valve by turning in (clockwise) $\frac{1}{4}$ turn record pressures analyze problem.			
.1.4	Check system for insufficient cooling.	9.1.4	Remove fan compartment panel check blower belt tension check air filter. Check blower for cleanliness replace fan compartment panel, remove access panel from evaporator compartment. Inspect evaporator.			

ACCREDITATION NUMBER 9015

COURSE TITLE: AIR CONDITIONING, REFRIGERATION AND HEATING- INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 10.0 TROUBLE SHOOTING

The student will trouble-shoot, Repair and place in operation a defective air conditioner/freezer/refrigerator so that it will perform within its original design specifications.

No.	Intermediate Performance Objectives	No.	Criterion Measures
		10.0	The process will be evaluated by means of the criteria in the objective.
10.1	Upon completion of this unit the student will be able to locate and correct problems occuring in the evaporator section.	10.1	The student will locate and identify a malfunction within the evaporator and correct it so that the component operates within the manufacturer's specifications.
10.2	Upon completion of this unit the student will be able to locate and correct problems occuring in the condensor section.	10.2	The student will locate and identify a malfunction within the condensor and correct it so that the component operates within manufacturer's specifications.
10.3	Upon completion of this unit the student will be able to locate and correct problems occuring in the compressor.	10.3	The student will locate and identify a malfunction within the compressor and correct it so that the component operates within manufacturer's specifications.
10.4	Upon completion of this unit the student will be able to locate and correct problems occuring in the metering device.	10.4	The student will locate and identify a malfunction within the metering device and correct it so that the component operates within manufacturer's specifications.
10.5	Upon completion of this unit the student will be able to locate and correct problems occuring in the controls.	10.5	The student will locate and identify a malfunction within the control devices and correct it so that the component operates within manufacturer's specifications.
10.6	Upon completion of this unit the student	10.6	The student will locate and identify a

ACCREDITATION NUMBER 9015

COURSE TITLE: AIR CONDITIONING, REFRIGERATION AND HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 10.0 TROUBLE SHOOTING

No.	Intermediate Performance Objectives	No.	Criterion Measures
10.6	(Con't.) will be able to locate and correct problems occuring in the automatic defrosting system.	10.6	(Con't.) malfunction within the automatic defrost system and correct it so that the component operates within manufacturer's specifications.

ACCREDITATION NUMBER 9015

COURSE TITLE: REFRIGERATION, AIR CONDITIONING AND HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 11.0 PERFORMANCE TEST

Upon completion of the unit on heating in air conditioning, 90% of the learners will establish proficiency by passing a performance test with a grade of 75%

No.	Intermediate Performance Objectives	No.	Criterion Measures
		11.0	The criterion shall be a: 1. Performance test. Disassemble and reassemble a high pressure gun type machine and name all parts. 2. A written test as attached.
11.1	After completing the unit of study fundamentals of heating, 90% of the students shall receive a grade of 75%.	11.1	The criterion shall be a written test on: 1) fuel oils 2) combustion 3) air requirements 4) components of a system 5) terminology A test is attached.
11.2	After completing the unit on piping and tank installation, 80% of the students will pass a test with a grade of 75%	11.2	The criterion shall be a written test covering: 1) piping 2) tanks 3) safety factors A sample test sheet is attached.
11.3	Upon completion of the unit, Pot type (vaporizing) oil burners, 90% of the learners shall achieve a grade of 75%.	11.3	The criterion shall be a performance test wherein the learner names the parts of a pot type (vaporizing) burner and the function of each part.

ACCREDITATION NUMBER 9015

COURSE TITLE: REFRIGERATION, AIR CONDITIONING AND HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 11.0 PERFORMANCE TEST

No.	Intermediate Performance Objectives	No.	Criterion Measures
11.4	When the student has completed the unit on vaporizing burner oil controls 90% of the learners shall attain a proficiency of 75% by assembling and disassembling an oil control.	11.4	The Criterion shall be proficiency in a performance test of dis-assembling and reassembling an oil control with ability to name the functions of the main parts.
11.5	Upon completion of the unit on high pressure gun type burners, 90% of the students shall attain a proficiency of 75% on a performance test.	11.5	The criterion shall be a performance test of dis-assembly and assembly of a burner. The student will: 1) be able to re-assemble burners and 2) name the parts.
11.6	Upon completion of the electrical wiring unit 80% of the students will pass a performance test of wiring a unit with a proficiency of 75%.	11.6	The criterion shall be a performance test of 1) Naming electrical components and functions. 2) Wiring the electrical components so the unit will operate.
11.7	After completion of the unit on trouble shooting 90% of the learners shall have attainted a grade of 75%	11.7	The criterion shall be a teacher devised test. 1) Deposits of soft carbon in heater may have been caused by insufficient draft. The reasons for insufficient draft may be: 2) The burner runs but no oil comes out. a. oil squirts out between nozzle and regulating valve. b. nozzle stoppage c. oil tank over-filled d. oil is by passed to pump inlet. 3) The job of the stock element is: a. Place burner into running cycle. b. Start the fan .

ACCREDITATION NUMBER 9015

COURSE TITLE: REFRIGERATION, AIR CONDITIONING AND HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 11.0 PERFORMANCE TEST

No.	Intermediate Performance Objectives	No.	Criterion Measures
11.7	(Con't.)	11.7	(Con't.) c. Shut off burner on high fire d. Open oil valve. 4. The thermostat should be located: a. On the heater b. Outisde wall c. In the hall d. None of these

ACCREDITATION NUMBER 9015

COURSE TITLE: AIR CONDITIONING, REFRIGERATION, AND HEATING - INTERMEDIATE

TERMINAL OBJECTIVE
OBJECTIVE NO. 12.0 SHOP MANAGEMENT

The student will with 80% proficiency draw an organization chart, enter an initial parts order and set up typical inventory cards for an air conditioning service shop.

No.	Intermediate Performance Objectives	No.	Criterion Measures
12.1	The student will with 80% proficiency draw an organization chart for an air conditioning service shop.	12.1	Draw an organization chart for an air conditioning service shop.
12.2	The student will with 80% proficiency make up an initial parts order for an air conditioning shop.	12.2	Make up an initial parts order for an air conditioning shop.
12.3	The student will with 80% proficiency set up a perpetual inventory card system for an air conditioning shop.	12.3	Set up a perpetual inventory card system for an air conditioning shop.

ACCREDITATION NUMBER 9017

COURSE TITLE: REFRIGERATION, AIR CONDITIONING AND HEATING, ADVANCED

TERMINAL OBJECTIVE
OBJECTIVE NO. 13.0 S.I.E. PROGRAM

Upon demonstrating 75% proficiency in the first and second year of training the student shall be selected for participation in the School-Industry Program for Refrigeration, Air Conditioning and Heating.

No.	Intermediate Performance Objectives	No.	Criterion Measures
		13.0	To enter S.I.E. Program the learner will be recommended by the instructor upon the students completion of 75% of the Basic and Intermediate Course Objectives.
13.1	The learner will achieve 80% as stated in the training agreements for the School Industry Education Program.	13.1	Employer and S.I.E. Coordinator Evaluation as per training agreement

ELECTRICAL TEST

1. Copy the below list and indicate the conductors by placing a "C" in front of that material and an "I" in front of the insulators.

1. Air	5. Copper	9. Rubber
2. Aluminum	6. Glass	10. Silver
3. Brass	7. Iron	
4. Bake Lite	8. Porcelain	

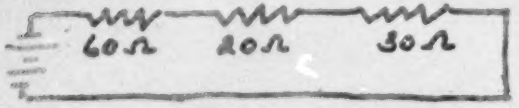
2. Electrical pressure is measured in:
a. Volts b. Amperes c. Ohms d. Resistance

3. Electrical current is measured in:
a. Volts b. Amperes c. Ohms d. Resistance

4. Opposition to the flow of electrical current is measured in:
a. Volts b. Amperes c. Ohms d. Resistance

5. Ohms Law may be stated as:
a. E=IR b. I=E/R c. R=E/I d. Any of the above

6.



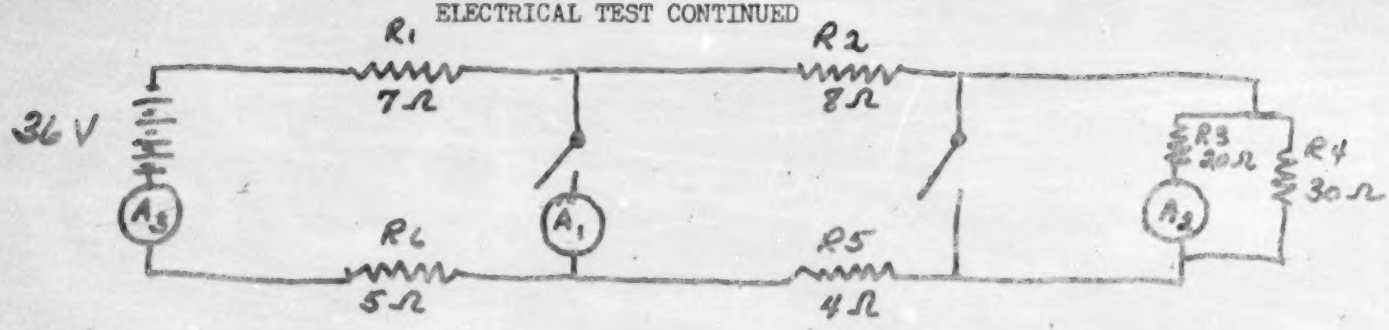
In the above problem what is total R.
a. 10 b. 60 c. 110 d. 116

7. In problem 6 what number more closely represents total "I".
a. 55 milliamps b. .5 milliamps c. 10 amps d. 110 amps

8. An applied voltage of 50 volts causes a current of 2 amps to flow. What is the resistance?
a. 40 ohms b. 25 ohms c. 40 milliamps d. 100 ohms

9. A meter indicates a current flow of 10 amps. The circuit resistance is 500 ohms. What is the value of E.
a. .02 b. 50 c. 500 d. 5000

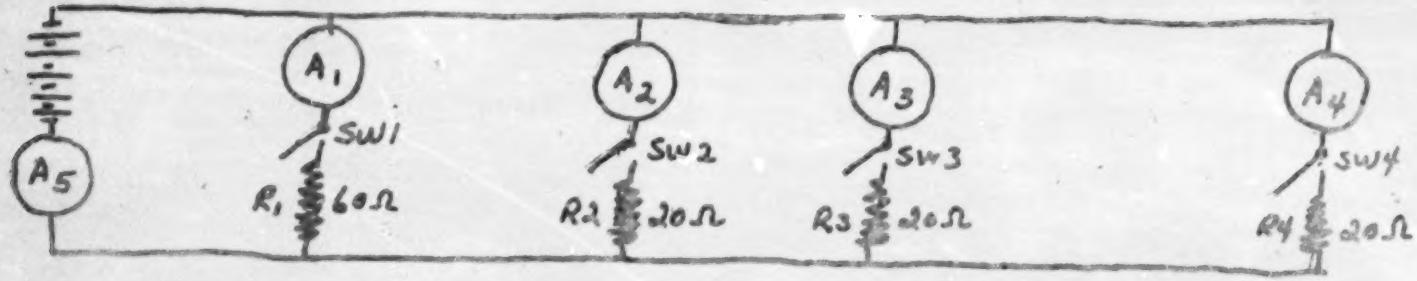
10. In a series circuit what is it that always remains constant.
a. Current b. Resistance c. Voltage d. All of the above



(WORK THE BELOW PROBLEMS, USING THE DIAGRAM ABOVE)

11. Find total resistance with SW_1 and SW_2 open.
12. Find total resistance with SW_1 closed and SW_2 open.
13. Find total resistance with SW_1 open and SW_2 closed.
14. What will A_3 read with SW_1 and SW_2 open?
15. What will A_3 read with SW_1 closed and SW_2 open?
16. What will A_3 read with SW_1 open and SW_2 closed?
17. What will A_2 read with SW_1 and SW_2 open?
18. What will A_2 read with SW_1 and SW_2 closed?
19. How much power is consumed with SW_1 and SW_2 open?
20. How much power is consumed with SW_1 closed and SW_2 open?
21. How much power is consumed with SW_1 open and SW_2 closed? (With SW_1 and SW_2 open compute the following).
22. E_{R_1}
23. E_{R_2}
24. E_{R_3}
25. E_{R_4}
26. E_{R_5}
27. E_{R_6}
28. A 110 volt motor uses 10 amps of current continously. How much power is used?
29. If the motor in problem 28, operated for 16 hours, how many KWH is consumed?
30. At 5¢ per kilowatt what would it cost to operate the motor in the problems 28 and 29?

ELECTRICAL TEST CONTINUED:



(Work the below problems using the diagram above.)

31. Close SW_1 then compute what A_1 will read.

32. Close SW_1 and SW_2 then compute what A_2 will read.

33. Close SW_1 and SW_2 then compute A_5.

34. Close SW_1 and SW_2 and SW_3 then compute for A_3.

35. Close SW_1 and SW_2 and SW_3 then compute for A_5.

36. Close switches 1, 2, 3, and 4 then compute for A_4.

37. Close switches 1, 2, 3, and 4 then compute for A_5.

38. Close SW_1 and compute R_T with all other switches open.

39. Close switches 1 and 2 and compute R_T with all other switches open.

40. Close switches 1, 2, and 3 compute R_T with all other switches open.

41. Close all switches and compute R_T.

42. Close SW_1 and compute voltage drop across R_1.

43. Close switches 1 and 2 and compute voltage drop across R_2

44. Close switches 1, 2, and 3 and compute voltage drop across R_3.

45. Close switches 1, 2, 3, and 4 and compute voltage drop across R_4.

Close all switches and compute for:

46. Power across R_1 (consumed)
47. Power across R_2 (consumed)

48. Power consumed across R_3.

49. Power consumed across R_4.

50. Total power consumed.

WRITTEN FINAL TEST

1. The common term used to express that unit of electrical measurement used to measure the quantity of electricity flowing is
   a. ohms b. voltage c. amperage d. wattage

2. Klectrical power is usually expressed in
   a. voltage b. amperage c. ohmage d. wattage

3. What is the usual results of excess current in a circuit?
   a. lights will dim b. the resistance increases c. amperage decreases
   d. some pieces of electrical equipment burns up

4. Which of the below is the correct ohms laws formula
   a. E=I.R b. I=E.R c. R=E.I d. any of the above is correct

5. If two 110 volt light bulbs were placed in series across a 110 volt source, would they function properly
   a. Yes b. No

6. How much resistance would a closed switch have
   a. an infinite moment b. none

7. Which of the below listed motor applications do not use a relay
   a. R.S.I.R. b. C.S.I.R. c. C.S.R. d. P.S.C.

8. Which of the below listed motor applications do not use capacitor/capacitors.
   a. RSIR b. CSIR c. CSR d. PSC

9. To connect a potential relay to a motor, the coil of the relay should be connected between what two terminals.
   a. 1-2 b. 2-5 c. 1-5 d. R-C

10. What two terminals measures the most resistance on a single-phase motor.
    a. C-S b. C-R c. S-R d. all combinations measure the same

11. About how much resistance is measured through the coil of a potential relay.
    a. 0 ohms b. 5000 ohms c. an infinite amount d. same as a current relay

12. With a unit that contains low voltage (approx. 24 volts) which of the below is usually in the low voltage circuit.
    a. compressor b. fan motor c. contractor d. thermostat

13. A ton of refrigeration is equal to
    a. 2000 Btuh b. 12000 Btuh c. 144,000 Btuh d. 288,000 Btuh

14. Which of the following separates the low side from the high side
    a. condenser b. receiver c. metering device d. evaporator

15. Which metering devices has no moving parts.
    a. low side float b. thermostatic expansion valve c. automatic expansion valve
    d. capillary tube

16. Which metering device is usually used on small domestic refrigerators
    a. low aide float b. thermostatic expansion valve c. automatic expansion valve
    d. capillary tube

17. In what component in a refrigeration system does the refrigerant absorb the most heat
    a. evaporator b. condenser c. compressor d. metering device

18. In what component in a refrigeration system does the refrigerant give up heat
    a. evaporator b. condenser c. compressor d. metering device

19. What type of metering device is never used in conjunction with a receiver
    a. low side flat b. thermostatic expansion valve c. capillary tube d. hand valve

20. The liquid line is attached to the
    a. condenser-compressor b. compressor-condenser c. condenser-metering device
    d. metering device-compressor

21. Within the System freezing at the expansion valve could be recognized by
    a. the low side pressure decreasing b. the high side pressure increasing
    c. the low side pressure increasing d. the high and low side pressures increasing

22. High head pressure may be caused by
    a. air in the system b. an overcharge of refrigerant c. a dirty condenser
    d. all of the above

23. A properly operating air conditioner using refrigerant 22 and having a 40° coil will have a back pressure of
    a. 0 b. 37 c. 69 d. 100

24. With a proper working air conditioner the approximate high side pressure of an air-cooled condenser using refrigerant 12 with ambient air 90°F
    a. 100 PSI b. 120 PSI c. 158 PSI d. 260 PSI

25. A refrigerator has the proper charge when the pressures are not abnormal and the
a. evaporator is sweated all the way b. frost line extends to the compressor
c. evaporator is frosted completed d. any of the above is correct

26. When charging refrigerant in a system, the suction service valve stem
a. will be back seated b. will be front seated c. will be in an intermediate position
d. may be front seated in an intermediate position

27. Moisture in a refrigerant system causes
a. copper plating b. metal corrosion and motor insulation deterioration
c. metering device "freeze-up" d. any of the above

28. Insulation is usually placed on the
a. condenser b. suction lines c. discharge lines d. evaporator

29. CCL_2F_2 is the chemical formula for
a. R-12 b. R-22 c. R-113 d. R-717

30. CH_2CL_2 is the chemical formula for
a. R-12 b. R-22 c. R-113 d. R-717

31. The oil safety switch is operated by
a. head pressure b. the sum of chrankcase pressure and oil pressure c. the difference between chrankcase pressure and oil pressure d. the difference between head pressure and oil pressure

32. Humidistat is operated by
a. temperature b. pressure c. moisture d. all of the above

33. The thermostatic expansion valve has three operating pressures.
a. evaporation pressure spring pressure, suction b. evaporation pressure, spring pressure condensing c. evaporation pressure, spring pressure, bulb temperature d. suction pressure, condensing, bulb temperature

34. The evaporator is a device to
a. absorb heat b. give up heat c. add heat d. decrease pressure

35. The condenser is to change
a. liquid to vapor b. gas to vapor c. low pressure to high pressure
d. high pressure to low pressure

36. A capillary is located
a. in liquid line feeding coil b. at the leaving side of coil c. in the hot gas line
d. at the condenser inlet

37. A refrigerant gives up heat when it
a. condenses b. evaporates c. vaporizes d. boils

38. For practical purposes the low side includes
a. condenser b. liquid line c. receiver d. metering device

39. For practical purposes the high side includes
a. condenser b. metering device c. receiver d. suction line

40. The cooling component of a refrigeration system is called
a. condenser b. compressor c. metering device d. evaporator

41. If a drum of R-12 partially filled with liquid refrigerant is stored in a 75°F. room the pressure on the drum will be
a. 37.0 PSI b. 76.9 PSI c. 105.0 PSI d. 126.5 PSI

42. If a drum of R-22 partially filled with liquid refrigerant is stored in a 75°F. room the pressure on the drum will be
a. 22.0 PSI b. 76.9 PSI c. 133.4 PSI d. 212.9 PSI

43. Hidden heat in refrigeration work is referred to as:
a. intensity of heat b. latent heat c. cold d. sensible heat

44. A thermometer responds to
a. heat of fusion b. latent heat c. sensible heat c. cold

45. What meter would you use to check a fuse if it is out of the circuit.
a. voltmeter b. ammeter c. ohmmeter d. any of the above

46. A ton of refrigeration is equal to:
a. 180 Btuh b. 2000 Btuh c. 10000 Btuh d. 12000 Btuh

47. Select a replacement from the below for the following start capacitor 1.0 MFD 220 VAC
a. 50 MFD 120 VAC b. 220 MFD 220 VAC c. 120 MFD 330 VAC d. 220 MFD 440 VAC

48. Four resistors are connected in series. They are $\frac{1}{2}$ ohms, 1/3 ohms, $\frac{1}{4}$ ohms. What is the total resistance?
a. 1/13 ohms b. 12/13 ohms c. 11/12 ohms d. 13 ohms

49. Four resistors are connected in parallel. They are 2 ohms, 3 ohms, 4 ohms. What is the total resistance?
a. 1/13 ohms b. 12/13 ohms c. 11/12 ohms d. 13 ohms

50. How much will it cost to operate an air conditioner for 30 days if the unit draws 9 amps while running plugged into a 220 volt source. It operates 16 hours a day, and costs $0.15 a kilowatt hour.
a. $9.51 b. $14.26 c. $19.80 d. $31.68

ELECTRICAL COMPONENTS

1. A unit has been designed to operate on 230 volts AC. What is the lowest voltage this unit will safely operate on?
   a. 115 volts b. 207 volts c. 220 volts d. 230 volts

2. In order for a starting relay to energize you must have voltage impressed on the
   a. coil b. contacts c. both a & b d. neither a nor b

3. Which capacitor has oil contained within
   a. start b. run c. both a and b

4. The purpose of oil in a capacitor is to
   a. help dissipate the heat b. to lubricate the capacitor c. the capacitor burns oil (as an auto does)

5. What is the best way to check a capacitor believed to be bad?
   a. Use an ohmmeter b. use a voltmeter c. use a wattmeter d. replace with a known good one

6. A closed switch on a compressor relay will offer
   a. "0" ohms resistance b. 5000 ohms resistance c. an infinite amount of resistance
   d. impossible to tell

7. If you are checking the contacts of a high pressure cut-out with a voltmeter and you read voltage across the contacts this indicates the contacts are
   a. opened b. closed

8. A normally ad compresser overload would, with an ohmmeter show
   a. direct short b. an open

9. A crankcase heater in a hermetic unit normally has voltage impressed on it when
   a. the unit is running b. the unit is not running c. all the time d. it is never used in a hermeti

10. What is the name of the component that furnished low voltage (18 volts) to low voltage circuits in a typical air conditioning schematic.
    a. battery b. generator c. alternator d. transformer

ELECTRICAL COMPONENTS CON'T.

11. Single phase fan motors that only have 2 electrical leads are of the
    a. Resistance start-induction run type b. Capacitor start-induction type
    c. Capacitor start-capacitor run type d. Shaded pole type

12. The switch that starts or stops single phase motors is wired in _____ with the motor.
    a. Series b. Parallel c. Either a or b

13. How many load devices are normally in one circuit in the Air Conditioning and Refrigeration field?
    a. 1 b. 2 c. 3 d. 4

14. The switch on a cooling thermostat will close on a/an
    a. Increase of pressure b. Increase of temperature c. Decrease of pressure d. Decrease of temperature

15. The switch on a heating thermostat will open on a/an
    a. Increase of pressure b. Increase of temperature c. Decrease of pressure d. Decrease of temperature

16. The switch on a high pressure cut out will open on a/an
    a. Increase of pressure b. Increase of temperature c. Decrease of pressure d. decrease of temperature

17. A good compressor overload with 3 terminals will have continuity between terminals
    a. 1 and 2 b. 1 and 3 c. 2 and 3 d. All of the above

18. The contacts of a potential relay are
    a. Normally closed b. Normally open

19. The coil of the current relay is in series with the
    a. Run winding b. Start winding c. Common winding

20. The run capacitor that is used on a permanent split phase is connected between the
    a. Run and common terminals b. Start and common terminals
    c. Run and start terminals d. In series with the run winding

Air Conditioning and Refrigeration Test

Applied Math

1. A factory department has 10 motors of 75, 30, 200, 40, 25, 15, 5, 125, 150, 175 hp. (horse power). What is the total combined horse-power of the 10 motors?

2. During a certain 12 week period the weekly consumption of electrical power in kilowatt hours in a certain house, due to airconditioning, was as follows: 45, 42, 38, 37, 32, 31, 33, 38, 40, 58: Find the total kilowatt hours consumed during this period.

3. A residence has lamps and appliances in its various rooms which have the following wattage: living room, 150w(watts): dining room, 125w: bathroom, 75w. What is the total load when all lamps and appliances are operating?

4. An Air Conditioning Contracter charged $239.00 for a job. The material cost him $105.00, labor $69.00 and transportation, etc. $5.00. What was his profit?

5. A coil of electrical cord, 270 feet long, was taken on a job. The following lengths were cut off for extention cords; two 30 feet, eight 6 feet, four 3 feet, two 25 feet, three 15 feet, and two 2 feet. How many feet of cord remained in the coil?

6. A customer receives a service bill for electricity. It reads total kwh. (kilowatthour) 1876.0. Of this 504 kwh was for lighting service, the balance for domestic hot water. How many kwh did the customer use for hot water?

7. A bearing on a large machine was tested over a period of 8 hours, at a speed of 675 rpms (revolutions per minute). How many rpm did the shaft turn in the bearing during the test periods?

8. A very small magnet wire was wound in layers of 215 turns per layer and 97 layers. How many turns of wire were on this coil?

9. If we were using, in a building, sixteen 50 watt, nine 15 watt, twelve

25 watt, six 75 watt and four 100 watt lamps. How many watts are consumed when all the lights in the building are burning?

10. A hotel with 22 rooms on each of the seven floors has 462 outlets. If each room has the same number of outlets, how many are there in each room?

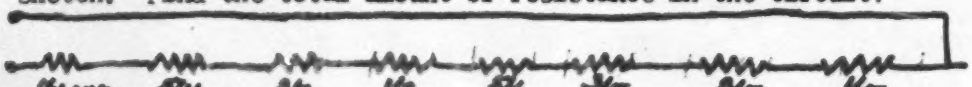
11. Two Air/Conditioning mechanics worked a total of 640 hours on the job. Each worked on an 8 hour, 5 day week schedule. How many weeks did each man work?

12. A certain machine room used 2160 watts for bench lighting. All of these were used by 60 watt bulbs. How many bulbs were connected?

13. Eight motors, having rated horsepower as indicated on the diagram below were connected in a circuit. What is the total hp. of motors no. 1 to no. 4 inclusive?

14. What is the total hp. of motors no. 5 to no. 8 inclusive shown below?

15. Eight resistors are connected in series as shown in the following sketch. Find the total amount of resistance in the circuit?



16. A piece of pipe with the outside diameter of 1" and a wall thickness of 1/8". What is the inside diameter?

17. A motor sleeve bearing is 3 1/16" outside diameter and 2 15/32 inside diameter. What is the thickness of the wall?

18. The flare nuts for a job weight 11/16 pounds each and 32 were required. Find the total weight of the flare nuts.

19. An air conditioning mechanic worked 4 3/4 hours a day on a certain job at $1.725 an hour. What was his pay for a 5 day work week?

20. A department in a factory had three 3/4 hp motors, five 1/4 hp. motors, six 3 1/3 motors and eight 7 1/2 hp. motors. What was the total connected motor load in horsepower rating?

21. How many 7 3/8" pieces of copper tubing can be cut from a 10 feet length?

22. A lot of copper fittings cost $3.69. If the price per fitting was 4 $\frac{1}{2}$ cents, how many fittings were in the lot?

23. A 20 feet length of copper tubing was cut in 6 3/4" pieces. How many pieces were made?

24. The actual inside diameter of a 1" pipe is 1.062" and the actual outside diameter is 1.315" . What is the thickness of the wall of this pipe?

25. An Air Conditioning mechanic received $250.00 for a 40 hours work week. What was his rate of pay per hour?

26. How much will it cost per hour to operate a heater that consumes .45 kw. per hour at the rate of $.04 per kw. hour?